NI Vision

NI CVS-1450 Series User Manual

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NATIONAL INSTRUMENTS™

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Determining FCC Class

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Depending on where it is operated, this Class A product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.) Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products.

All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

Consult the FCC Web site at `www.fcc.gov` for more information.

FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE marking Declaration of Conformity*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by NI could void the user's authority to operate the equipment under the FCC Rules.

Class A

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is required to correct the interference at their own expense.

Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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* The CE marking Declaration of Conformity contains important supplementary information and instructions for the user or installer.

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About This Manual

NI CVS-1450 Series devices are easy-to-use, distributed, real-time imaging systems that acquire, process, and display images from IEEE 1394 cameras conforming to the *IIDC 1394-based Digital Camera Specification, Version 1.30*. The NI CVS-1450 Series also provides multiple digital input/output (I/O) options for communicating with external devices to configure and start an inspection and to indicate results.

Conventions

The following conventions are used in this manual:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
	This icon denotes a tip, which alerts you to advisory information.
	This icon denotes a note, which alerts you to important information.
	This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
bold	Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes hardware labels and parameter names.
italic	Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- *Getting Started with the NI CVS-1450 Series Compact Vision System*—Contains information about installation, software configuration, and product specifications.
- *NI Vision Acquisition Software Release Notes*—Outlines new functionality, system requirements, installation procedures, and descriptions of the documentation included with the NI-IMAQdx driver software.
- *Measurement & Automation Explorer Help for NI-IMAQdx*—Describes how to configure the NI-IMAQdx driver software, NI interface devices, and cameras using Measurement & Automation Explorer (MAX).
- *NI-IMAQdx Help*—Contains fundamental programming concepts for the NI-IMAQdx driver software and terminology for using NI image acquisition devices.

1

NI CVS-1450 Series Overview

This chapter provides an overview of the features and components of the National Instruments CVS-1450 Series compact vision system.

About the NI CVS-1450 Series

NI CVS-1450 Series devices are easy-to-use, distributed, real-time imaging systems that acquire, process, and display images from IEEE 1394 cameras conforming to the *IIDC 1394-based Digital Camera Specification, Version 1.30*. The NI CVS-1450 Series also provides multiple digital input/output (I/O) options for communicating with external devices to configure and start an inspection and to indicate results.

An Ethernet connection between the NI CVS-1450 device and a development computer allows you to display measurement results and status information and to configure the NI CVS-1450 device settings. When configured, the NI CVS-1450 device can run applications without a connection to the development computer.

Each NI CVS-1450 device ships with documentation and NI Vision Acquisition Software which includes the NI-IMAQdx driver software. The NI Vision Acquisition Software is licensed for one development system and one deployment system.

Hardware Overview

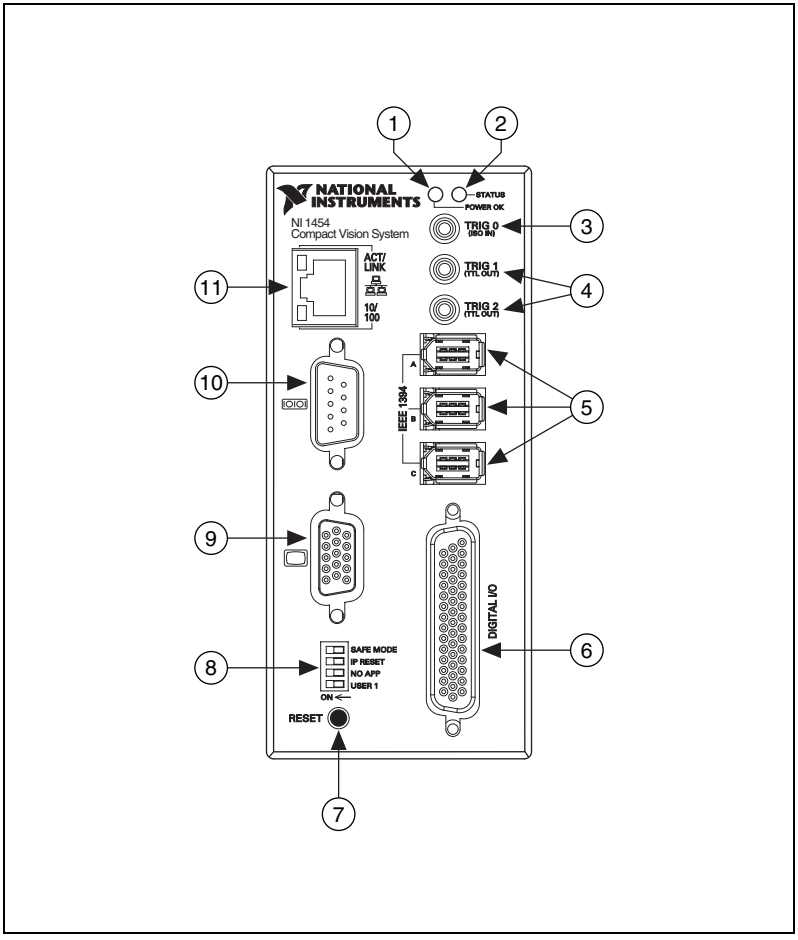
The NI CVS-1450 device front panel consists of a VGA connector, RS-232 serial port, 10/100 Ethernet connector, and three IEEE 1394a ports.

Caution The isolation on the NI CVS-1450 device is *not* safety isolation.

The NI CVS-1450 device also includes LEDs for communicating system status, DIP switches that specify startup options, TTL inputs and outputs for triggering, and isolated inputs and outputs for connecting to external devices, such as programmable logic controllers (PLCs), sensors, LED indicators, and start/stop buttons. The isolated inputs and outputs on the

NI CVS-1450 device provide an easy means for preventing ground loops that could degrade signal integrity.

Figure 1-1 shows the NI CVS-1450 Series front panel.



1	Power LED	7	Reset Button
2	Status LED	8	DIP Switches
3	Isolated Digital Input	9	VGA
4	TTL Digital Outputs	10	RS-232 Serial Port
5	IEEE 1394a Ports	11	RJ-45 Ethernet Port
6	TTL I/O and Isolated I/O		

Figure 1-1. NI CVS-1450 Series Front Panel

Functional Overview

Figure 1-2 illustrates the key functional components of the NI CVS-1450 Series.

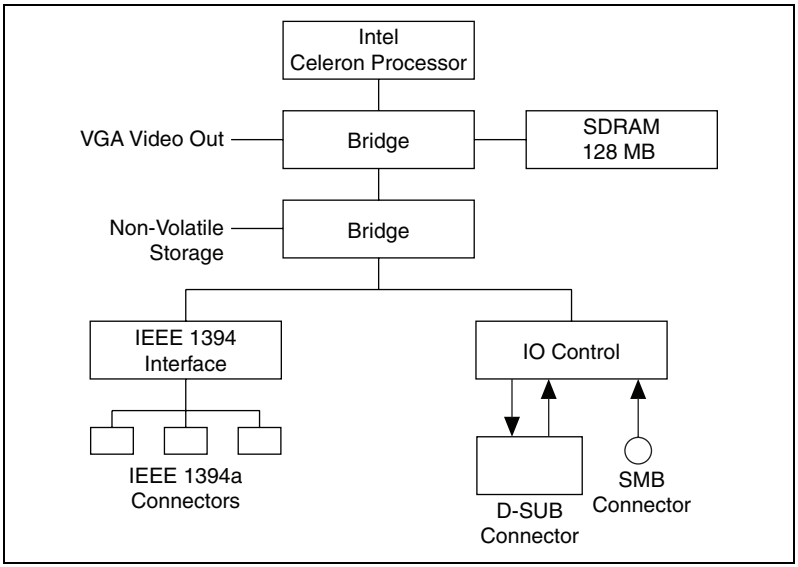


Figure 1-2. NI CVS-1450 Series Block Diagram

Available Camera Bandwidth

The IEEE 1394 bus provides a fixed amount of bandwidth that is shared among the three IEEE 1394a ports on the NI CVS-1450 device. These ports provide direct connection for up to three DCAM-compliant IEEE 1394 cameras, depending on the amount of bandwidth each camera requires. Higher frame rates and larger image sizes require a higher data transfer rate and use more bandwidth.

Table 1-1 shows the maximum number of cameras the NI CVS-1450 device supports for three common video formats. Use this table as a guide when determining the combination of cameras to use in your application.

Note Bandwidth calculations described in Table 1-1 do not include software decoding of YUV images to RGB. This conversion time is dependent on processor speed.

By triggering your cameras at a frame rate slower than those rates listed in Table 1-1, you can operate more cameras simultaneously. If the camera

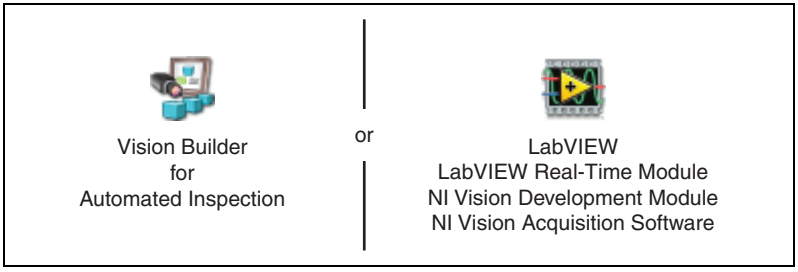
combination exceeds the amount of available bandwidth, the software returns an Insufficient Resources error.

Table 1-1. Available Camera Bandwidth

Video Format	Frames per Second	Maximum Number of Cameras for Simultaneous Operation
640 × 480 8-bits/pixel mono	30	3
	60	1
	100	1
640 × 480 YUV (4:2:2) 16-bits/pixel color	15	3
	30	1
1024 × 768 16-bits/pixel mono	7.5	2
	15	1

Software Overview

Developing applications with the NI CVS-1450 device requires one of the following software options:



The installation and configuration process for each development environment is different. Refer to *Getting Started with the NI CVS-1450 Series Compact Vision System* for installation and configuration instructions.

The following sections describe the software options. For detailed information about individual software packages, refer to the documentation specific to the package.

NI Vision Builder for Automated Inspection (Vision Builder AI)

Vision Builder AI is configurable machine vision software that you can use to prototype, benchmark, and deploy machine vision applications. Creating applications in Vision Builder AI does not require programming. However, Vision Builder AI applications are scalable to the LabVIEW Real-Time Module. It also allows you to easily configure and benchmark a sequence of visual inspection steps, as well as deploy the visual inspection system for automated inspection. With Vision Builder AI, you can perform powerful visual inspection tasks and make decisions based on the results of individual tasks. You can also migrate your configured inspection to LabVIEW, extending the capabilities of your applications if necessary.

Vision Builder AI allows you to remotely configure and control the device. To use a NI CVS-1450 device with Vision Builder AI, you must install one of the following options for driver software.

- **Vision Builder AI 3.0 or later**—No additional software is needed. Vision Builder AI is configurable software for building, benchmarking, and deploying machine vision applications. Vision Builder AI does not require programming. A built-in deployment interface is included so you can quickly deploy your inspection, guidance, and identification applications. Vision Builder AI also includes the ability to set up complex pass/fail decisions to control digital I/O devices and communicate with Ethernet devices such as PLCs, PACs, and HMIs.
- **Vision Builder AI 2.0 through 3.0**—Install one of the following driver software applications to configure your NI CVS-1450 device to acquire images with Vision Builder AI:
  - NI-IMAQ for IEEE 1394 Cameras 2.0 or later
  - NI-IMAQdx 3.0 or later with Legacy NI-IMAQ for IEEE 1394 Cameras Support enabled

Note If you are using Vision Builder AI with a CVS-1450 device, you must install the driver software after you install Vision Builder AI. For more information, refer to *Getting Started with the NI CVS-1450 Series Compact Vision System*, included with every CVS-1450 device.

LabVIEW

LabVIEW is a graphical programming environment for developing flexible and scalable applications. To develop machine vision applications with the NI CVS-1450 and LabVIEW, you must have the following add-on

modules: LabVIEW Real-Time Module, Vision Development Module, and Vision Acquisition Software.

LabVIEW Real-Time Module

The LabVIEW Real-Time Module combines LabVIEW graphical programming with the power of Real-Time (RT) Series hardware, such as the NI CVS-1450 Series, enabling you to build deterministic, real-time systems. You develop VIs in LabVIEW and embed the VIs on RT targets. The RT target runs VIs without a user interface and offers a stable platform for real-time VIs. For more information about the LabVIEW Real-Time Module, refer to the *LabVIEW Help*.

NI Vision Development Module

The NI Vision Development Module is an image acquisition, processing, and analysis library of more than 270 functions for the following common machine vision tasks:

- Pattern matching
- Particle analysis
- Gauging
- Taking measurements
- Grayscale, color, and binary image display

With the NI Vision Development Module you can acquire, display, and store images as well as perform image analysis and processing. Using the NI Vision Development Module, imaging novices and experts can program the most basic or complicated image applications without knowledge of particular algorithm implementations.

NI Vision Assistant, which is included with the NI Vision Development Module, is an interactive prototyping tool for machine vision and scientific imaging developers. With Vision Assistant, you can prototype vision applications quickly and test how various vision image processing functions work. Using the Vision Assistant LabVIEW VI creation wizard, you can create LabVIEW VI block diagrams that perform the prototype you created in Vision Assistant. You can use them in LabVIEW to add functionality to the generated VI.

For information about how to use the NI Vision Development Module with the LabVIEW Real-Time Module, refer to the *NI Vision for LabVIEW Help*.

NI Vision Acquisition Software

The NI Vision Acquisition Software CD contains Measurement & Automation Explorer (MAX) and NI-IMAQdx driver software.

Use MAX to configure the NI CVS-1450 device. You can set the IP address, update software on the CVS-1450 device, configure triggering, and setup the lighting features.

The NI-IMAQdx driver software ships with the NI CVS-1450 device. NI-IMAQdx is the interface path between the application software and the NI CVS-1450 device. NI-IMAQdx is part of the NI Vision Acquisition software.

NI-IMAQdx includes an extensive library of VIs you can call from LabVIEW. These VIs include routines for video configuration, continuous and single-shot image acquisition, trigger control, and register-level camera configuration. NI-IMAQdx also handles many of the complex issues between the NI CVS-1450 device and the camera, such as IEEE 1394 bus communication and camera control.

The NI-IMAQdx driver software performs all functions necessary for acquiring and saving images but does not perform image analysis. For image analysis functionality, refer to the *NI Vision Builder for Automated Inspection (Vision Builder AI)* section.

NI-IMAQdx features both high-level and low-level functions. A function that acquires images in multi-buffer, single-shot, or continuous mode is an example of a high-level function. A function that requires advanced understanding of the NI CVS-1450 device and image acquisition, such as configuring an image sequence, is an example of a low-level function.

2

LEDs, DIP Switches, and Connectors

This chapter provides information about the location and functionality of the LED indicators, DIP switches, and connectors on the NI CVS-1450 device. The *Connectors* section provides signal names and descriptions for each connector.

LED Indicators

Figure 2-1 shows the location of the **POWER OK** and **STATUS** LEDs on the NI CVS-1450 device.

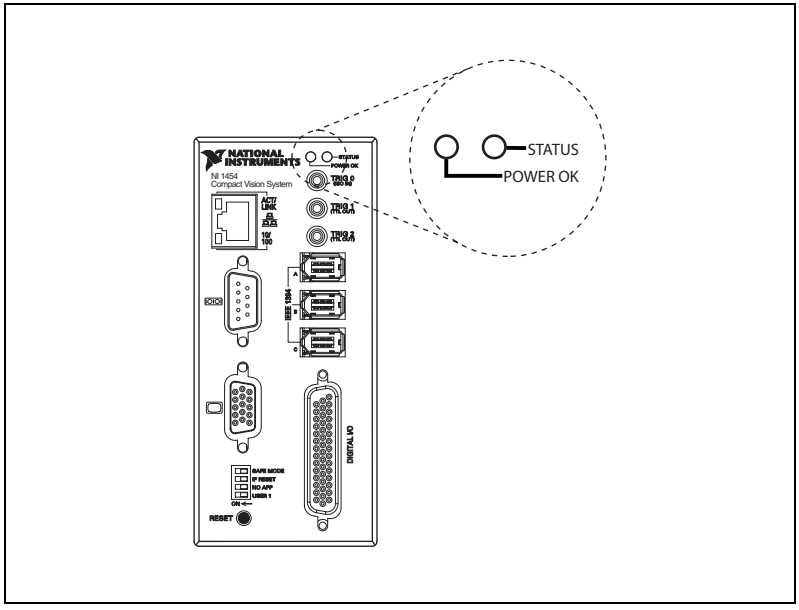


Figure 2-1. POWER OK and STATUS LEDs

Refer to Appendix A, *Troubleshooting*, for information about troubleshooting LEDs.

POWER OK LED

Under normal operating conditions, the **POWER OK** LED remains green while the NI CVS-1450 device is powered on. A green **POWER OK** LED indicates that NI CVS-1450 device main power is receiving power and that the NI CVS-1450 device is not in a fault state. A red **POWER OK** LED indicates that the NI CVS-1450 device has shut down because of a fault state. A fault state occurs when the user shutdown input is asserted, the processor overheats, or the watchdog timer expires.

Note The **POWER OK** LED does *not* indicate the status of the isolated power, V_{iso}.

STATUS LED

The orange **STATUS** LED remains off under normal operating conditions and flashes a specific number of times to indicate error conditions or certain DIP switch settings. The **STATUS** LED remains lit if the NI CVS-1450 device detects an internal error.

Refer to the *Hardware Errors* section of Appendix A, *Troubleshooting*, for information about LED error indications.

ACT/LINK LED

The orange **ACT/LINK** LED blinks when the NI CVS-1450 device receives data from or transmits data to the network through the Ethernet connection. Unrelated network activity causes this LED to blink occasionally even when the NI CVS-1450 device is inactive.

Figure 2-2 shows the location of the **ACT/LINK** LED on the NI CVS-1450 device.

10/100 Mbps LED

The green **10/100 Mbps** LED is lit when the network provides 10/100 Mbps support and the NI CVS-1450 device is communicating at 10/100 Mbps. If the **10/100 Mbps** LED is not lit, the NI CVS-1450 device is not operating at 10/100 Mbps.

Figure 2-2 shows the location of the **10/100 Mbps** LED on the NI CVS-1450 device.

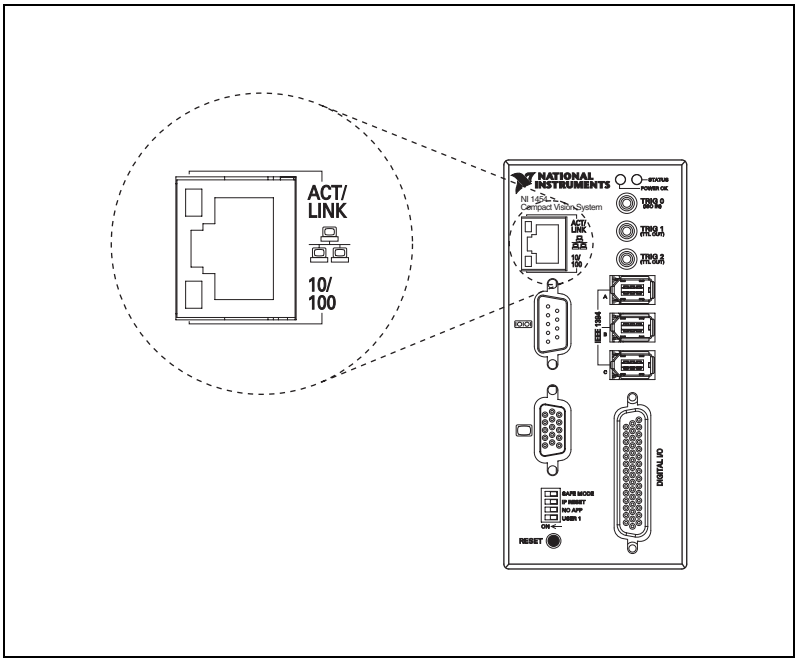


Figure 2-2. ACT/LINK and 10/100 Mbps LEDs

DIP Switches

This section describes the **SAFE MODE**, **IP RESET**, **NO APP**, and **USER 1** DIP switches on the NI CVS-1450 device.

To enable a DIP switch, move the switch to the **ON** (left) position and then reset the NI CVS-1450 device by pressing the **RESET** button for at least two seconds.

Note You must reset the NI CVS-1450 device in order for the setting change to occur.

Figure 2-3 shows the location of the DIP switches on the NI CVS-1450 device.

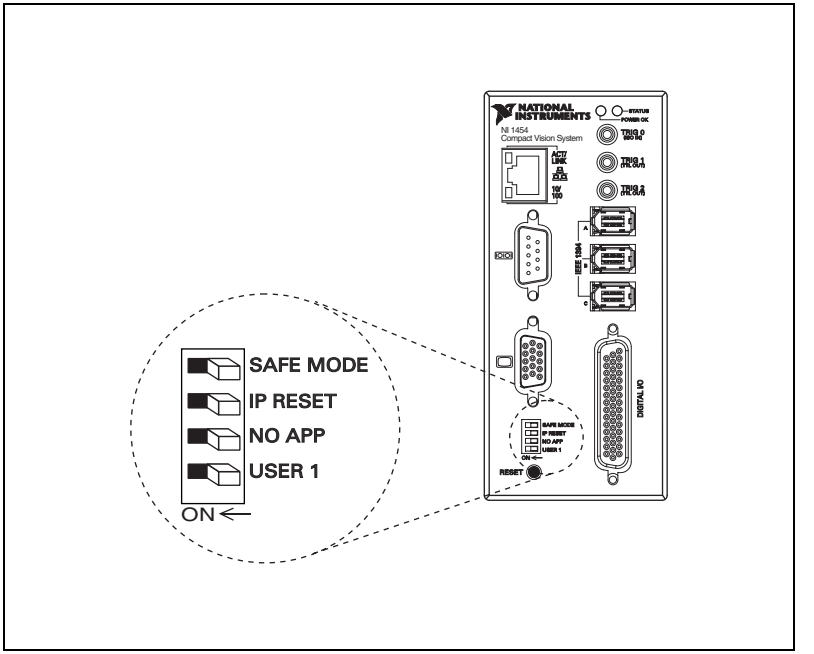
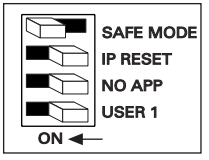


Figure 2-3. DIP Switches

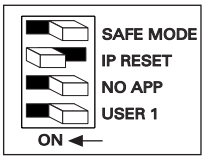
SAFE MODE Switch



To start the NI CVS-1450 device in safe mode, move the **SAFE MODE** switch to the **ON** position and reset the NI CVS-1450 device. Use safe mode to reconfigure TCP/IP settings and to download or update software from the development computer.

Downloading incorrect software to the NI CVS-1450 device may cause it to hang during restart or become inaccessible over the network. Powering on or resetting the NI CVS-1450 device in safe mode starts the NI CVS-1450 device but does not start the embedded LabVIEW Real-Time engine. To resume normal operations, restart the NI CVS-1450 device with the **SAFE MODE** switch in the **OFF** position.

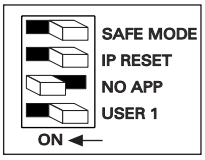
IP RESET Switch



To clear the NI CVS-1450 device IP settings, move the **IP RESET** switch to the **ON** position and reset the NI CVS-1450 device. Use **IP RESET** to reset the TCP/IP settings when moving the system from one subnet to another or when the current TCP/IP settings are invalid.

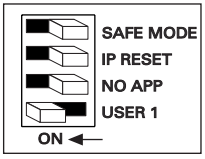
Resetting the NI CVS-1450 device with the **IP RESET** switch in the **ON** position resets the IP address to `0.0.0.0`. You can then set up a new network configuration for the NI CVS-1450 device from a development machine on the same subnet, or you can use an Ethernet crossover cable to connect the NI CVS-1450 device directly to the development computer.

NO APP Switch



To prevent the NI CVS-1450 device from automatically running VIs at startup, move the **NO APP** switch to the **ON** position and reset the NI CVS-1450 device. If the NI CVS-1450 device becomes inaccessible because of a startup program, enable the **NO APP** switch and reset the NI CVS-1450 device.

USER 1 Switch (LabVIEW Real-Time Module Users)



The **USER 1** switch is user-configurable and has no default functionality. Use the RT Read Switch VI to read the **USER 1** switch state and perform a custom action based on the current switch state position.

Connectors

This section describes the connectors on the NI CVS-1450 device and includes pinouts and signal descriptions for each connector.

Table 2-1 summarizes the functions of the connectors on the NI CVS-1450 device.

Table 2-1. NI CVS-1450 Device Connectors Overview

Peripheral	External Connectors	Function
Power	4-position power connector	Main power and power for isolated outputs
IEEE 1394a	6-pin IEEE 1394	Power and data connection to IEEE 1394 cameras
VGA	15-pin female DSUB (standard VGA)	Video output
Serial	9-pin male DSUB (standard RS-232 serial port)	COM1
10/100 Ethernet	RJ-45 (standard Ethernet port)	Ethernet network connection
TRIG 0	SMB receptacle	External isolated trigger input
TRIG 1 and TRIG 2	SMB receptacle	External TTL output
Digital Input/Output	44-pin female high-density DSUB	External TTL I/O; External isolated I/O

Power Connector

The power connector on the NI CVS-1450 device accommodates two power supplies. The terminals labeled **V** and **C** provide the voltage and common-mode signal for the main power of the NI CVS-1450 device. The terminals labeled $\mathbf{V_{iso}}$ and $\mathbf{C_{iso}}$ provide the voltage and common-mode signal to power the isolated output circuitry.

Caution The isolation provided by the NI CVS-1450 device is intended to prevent ground loops that could introduce noise into the system. This isolation does *not* provide safety isolation.

Figure 2-4 shows the power connector on the NI CVS-1450 device. Table 2-2 lists and describes each terminal on the power connector.

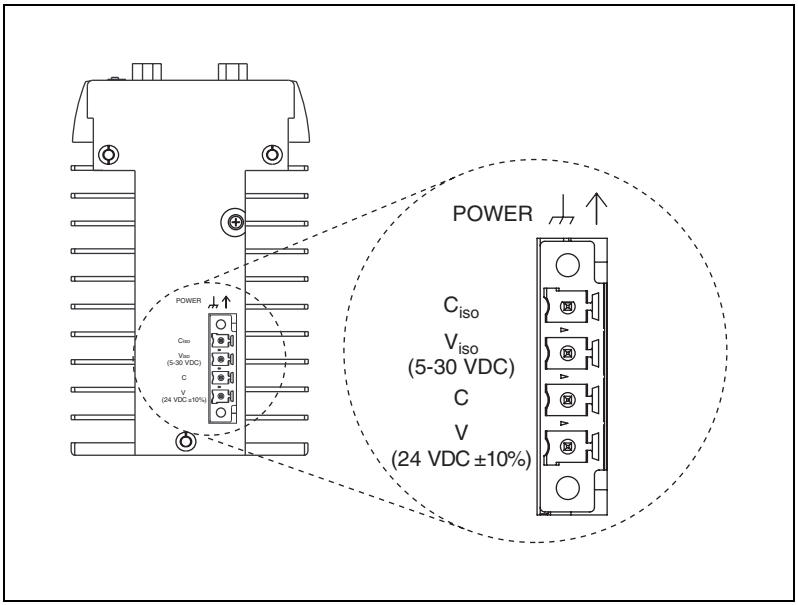


Figure 2-4. Power Connector

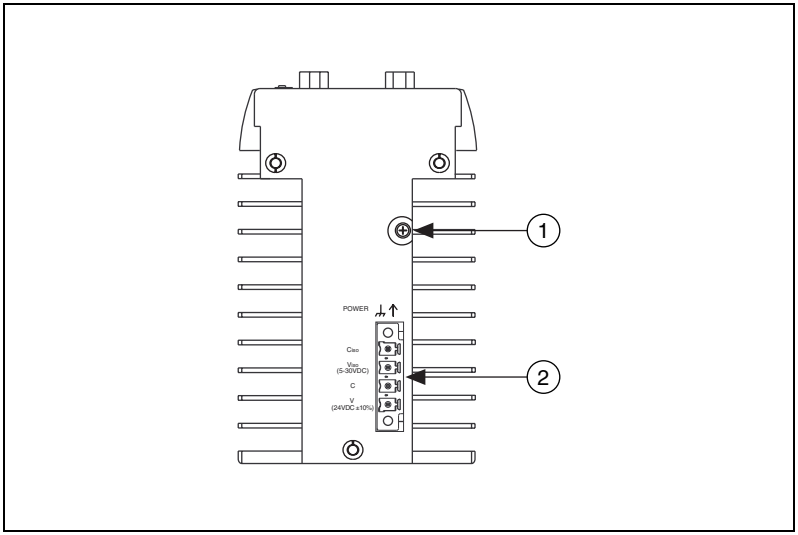
Table 2-2. Power Connector Terminals

Terminal	Description
V	Main power (24 VDC ±10%)
C	Common-mode signal
V_{iso}	Isolated power (5 to 30 VDC)
C_{iso}	Isolated common-mode signal

Earth Ground Connection

Some system setups may require using the grounding lug on the NI CVS-1450 device to connect the chassis to earth ground. Connecting the grounding lug, shown in Figure 2-5, to earth ground connects the common-mode signal of the main power to earth ground through the NI CVS-1450 device chassis.

Note An earth ground connection does *not* connect C_{iso} to earth ground.



1	Grounding Lug	2	Power Connector

Figure 2-5. Grounding Lug on the NI CVS-1450 Device

IEEE 1394

The IEEE 1394 connectors on the NI CVS-1450 device provide a reliable, high-frequency connection between the NI CVS-1450 device and up to three DCAM-compliant IEEE 1394 cameras. For information about the amount of bandwidth available for connecting cameras, refer to the *Available Camera Bandwidth* section of Chapter 1, *NI CVS-1450 Series Overview*.

To access the IEEE 1394 connectors on the NI CVS-1450 device, use any standard 6-pin IEEE 1394 cable.

Note You can use a 4-pin to 6-pin converter cable with cameras that have their own external power supply and do not require power from the IEEE 1394 bus.

VGA

The VGA connector on the NI CVS-1450 device provides connection between the NI CVS-1450 device and a VGA monitor. Use any standard 15-pin VGA cable to access the VGA connector. Figure 2-6 shows the location and pinout of the VGA connector.

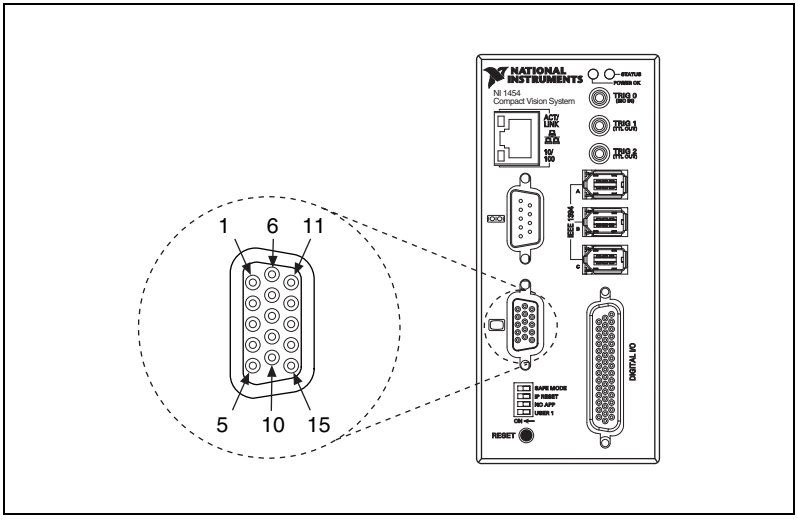


Figure 2-6. VGA Connector

Table 2-3 lists pin numbers, signal names, and signal descriptions for the 15-pin VGA connector on the NI CVS-1450 device.

Table 2-3. VGA Connector Signals

Pin Number	Signal Name	Signal Description
1	R	Red
2	G	Green
3	B	Blue
4	NC	No Connect
5	C	Common-mode signal of the NI CVS-1450 device main power
6	C	Common-mode signal of the NI CVS-1450 device main power
7	C	Common-mode signal of the NI CVS-1450 device main power
8	C	Common-mode signal of the NI CVS-1450 device main power
9	+5 V	+5 V

Table 2-3. VGA Connector Signals (Continued)

Pin Number	Signal Name	Signal Description
10	C	Common-mode signal of the NI CVS-1450 device main power
11	NC	No Connect
12	SD	Serial Data
13	HSync	Horizontal Sync
14	VSync	Vertical Sync
15	SC	Serial Clock

COM1

COM1 is a high-speed RS-232 (DTE) serial port used for connecting to serial devices, such as PLCs, scanners, and lighting devices.

Note The Serial Port VIs access COM1 as Port 0.

Figure 2-7 shows the location and pinout of the COM1 DSUB 9-pin connector.

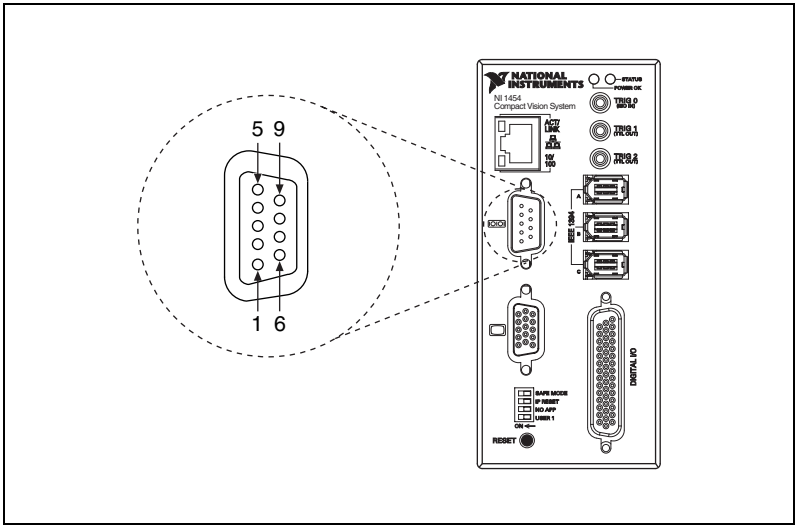


Figure 2-7. COM1 DSUB 9-Pin Connector

Table 2-4 lists pin numbers, signal names, and signal descriptions for the 9-pin COM1 connector on the NI CVS-1450 device.

Table 2-4. COM1 Connector Signals

Pin Number	Signal Name	Signal Description
1	DCD	Data Carrier Detect
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready
5	C	Common-mode signal of the NI CVS-1450 device main power
6	DSR	Data Set Ready
7	RTS	Ready to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

Ethernet

The Ethernet port on the NI CVS-1450 device provides connection between the NI CVS-1450 device and the development computer, either directly or through a network port. The NI CVS-1450 device automatically detects the speed of the connection and configures itself accordingly.

If you are connecting the NI CVS-1450 device to the development computer through a network port, use a standard Ethernet cable. To connect the NI CVS-1450 device directly to the development computer, use an Ethernet crossover cable.

TRIG 0

The TRIG 0 isolated input on the NI CVS-1450 device provides connection to external devices, such as proximity sensors and start/stop buttons. For easy connection to the TRIG 0 input, use the National Instruments SMB 111 coaxial cable (part number 763422-01).

Note Additional isolated inputs are available on the 44-pin DSUB connector.

Caution These isolated inputs are compatible with 5 V logic if the external circuit meets the voltage and current requirements listed in the *Specifications* section of *Getting Started with the NI CVS-1450 Series Compact Vision System*.

TRIG 1 and TRIG 2

You can use the two TTL outputs available on the SMB connectors for triggering cameras and external interfaces, such as lighting control units. For easy connection to the TTL outputs, use the National Instruments SMB 111 coaxial cable (part number 763422-01).

Note Additional TTL outputs are available on the 44-pin DSUB connector.

Caution Do *not* connect voltage or current sources to TTL outputs. Doing so could damage the NI CVS-1450 device.

General-Purpose Digital I/O

The 44-pin DSUB connector, shown in Figure 2-8, provides access to the general-purpose digital inputs and outputs. The general-purpose digital I/O available on this connector includes 2 TTL inputs, 8 TTL outputs, 12 isolated inputs, and 4 isolated outputs. For easy connection to the digital I/O connector, use the NI Vision I/O Terminal Block and Prototyping Accessory (part number 779166-01).

For detailed information about digital I/O functionality and recommended use cases, refer to Chapter 3, *Digital I/O Functionality*.

Note Isolated inputs are compatible with 5 V logic if the external circuit meets the voltage and current requirements listed in the *Specifications* section of *Getting Started with the NI CVS-1450 Series Compact Vision System*.

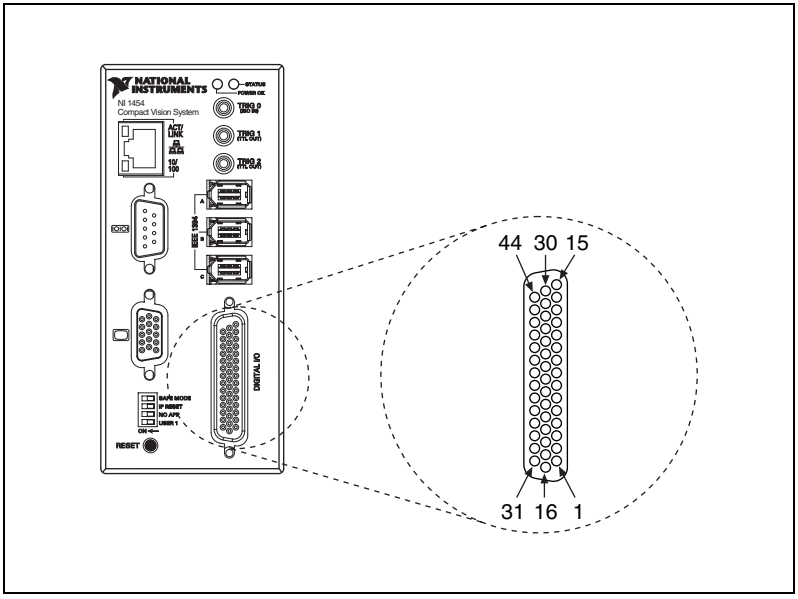


Figure 2-8. 44-Pin DSUB Connector

Table 2-5 lists pin numbers, signal names, and signal descriptions for the 44-pin connector on the NI CVS-1450 device and the 37-pin connector on the NI Vision I/O Terminal Block and Prototyping Accessory.

Caution Do *not* draw more than 500 mA combined from the V_{iso} pins on the 44-pin DSUB connector. Do *not* draw more than 100 mA from 24 V or 30 V isolated outputs. Do *not* draw more than 50 mA from 5 V isolated outputs.

Table 2-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals

44-Pin DSUB on NI CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
1	1	TTL Input 0	Pulse generator trigger input	General-purpose input
2	3	C	Common-mode signal of the NI CVS-1450 device main power	—
3	4	TTL Output 0	Watchdog timer output	General-purpose output

Table 2-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals (Continued)

44-Pin DSUB on NI CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
4	5	TTL Output 1	Pulse generator output	General-purpose output
5	6	C	Common-mode signal of the NI CVS-1450 device main power	—
6	7	TTL Output 2	Pulse generator output	General-purpose output
7	8	TTL Output 3	Pulse generator output	General-purpose output
8	6	C	Common-mode signal of the NI CVS-1450 device main power	—
9	NC	NC	No connect	—
10	17	V_{iso}	Isolated power	—
11	18	C_{iso}	Isolated common-mode signal	—
12	19	ISO Output 0	General-purpose output	—
13	35	ISO Output 1	General-purpose output	—
14	34	C_{iso}	Isolated common-mode signal	—
15	9	ISO Input 0	Input port, Data(0)	—
16	2	TTL Input 1	Pulse generator trigger input	General-purpose input
17	3	C	Common-mode signal of the NI CVS-1450 device main power	—
18	20	TTL Output 4	Pulse generator output	General-purpose output
19	21	TTL Output 5	General-purpose output	—
20	22	C	Common-mode signal of the NI CVS-1450 device main power	—
21	23	TTL Output 6	General-purpose output	—
22	24	TTL Output 7	General-purpose output	—

Table 2-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals (Continued)

44-Pin DSUB on NI CVS-145 0 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
23	22	C	Common-mode signal of the NI CVS-1450 device main power	—
24	NC	NC	No connect	—
25	33	V_{iso}	Isolated power	—
26	34	C_{iso}	Isolated common-mode signal	—
27	36	ISO Output 2	General-purpose output	—
28	37	ISO Output 3	General-purpose output	—
29	12	C_{iso}	Isolated common-mode signal	—
30	10	ISO Input 1	Input port, Data(1)	—
31	11	ISO Input 2	Input port, Data(2)	—
32	13	ISO Input 3	Input port, Data(3)	—
33	16	C_{iso}	Isolated common-mode signal	—
34	14	ISO Input 4	Input Port, Data(4)	—
35	15	ISO Input 5	Input port latch, Data(5)	Pulse generator trigger input
36	28	C_{iso}	Isolated common-mode signal	—
37	25	ISO Input 6	Quadrature encoder Phase A	General-purpose input
38	26	ISO Input 7	Quadrature encoder Phase B	General-purpose input
39	28	C_{iso}	Isolated common-mode signal	—
40	27	ISO Input 8	Pulse generator trigger input	General-purpose input
41	29	ISO Input 9	General-purpose input	General-purpose input

Table 2-5. 44-Pin DSUB and 37-Pin Terminal Block Connector Signals (Continued)

44-Pin DSUB on NI CVS-145 0 Device Pin Number	37-Pin Terminal Block Pin Number	Signal Name	Primary Function	Alternate Function
42	32	C_{iso}	Isolated common-mode signal	—
43	30	ISO Input 10	General-purpose input	General-purpose input
44	31	ISO Input 11	User shutdown	General-purpose input

3

Digital I/O Functionality

This chapter describes the primary functions of the digital inputs and outputs on the NI CVS-1450 device. This chapter also includes guidelines for connecting digital I/O and for setting up a typical NI CVS-1450 device.

Overview

The digital I/O functions are accessible through 2 TTL inputs, 10 TTL outputs, 13 isolated inputs, and 4 isolated outputs.

You can use input signals as triggers, product selection ports, or to read quadrature encoders. Uses for output signals include controlling camera reset and exposure, controlling strobe lighting, outputting inspection results, or communicating with PLCs. Refer to the NI-IMAQ I/O documentation and examples in the following location:

- `<LabVIEW>\examples\imaq\imaqio.llb`

You can also define custom functions for the digital input and output signals. For information about how to use the LabVIEW FPGA Module to implement custom digital I/O functions, refer to the application software documentation and examples in the following location:

- `<LabVIEW>\examples\imaq\imaqio fpga.llb`

The *NI-IMAQ I/O Terminal Reference Help* contains digital I/O reference information and instructions for using the LabVIEW FPGA VIs.

Tip To quickly launch the digital I/O help from a LabVIEW example, press <F1>.

TTL and Isolated Inputs and Outputs

This section describes the TTL and Isolated I/O functions available on the NI CVS-1450 device.

TTL Inputs and Outputs

TTL is a fast-switching, 5 V, digital, signaling standard commonly used for applications that require high precision, such as camera triggering. TTL inputs and outputs do not require a separate power supply.

Caution Do *not* connect voltage or current sources to TTL outputs. Doing so could damage the NI CVS-1450 device.

Table 3-1 summarizes the TTL inputs and outputs available on the NI CVS-1450 device.

Table 3-1. TTL Inputs and Outputs

Primary Function	Input or Output	Number Available	Signal Names	44-Pin DSUB on NI CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number
Trigger	Input	2	TTL Input 0 TTL Input 1	1 16	1 2
Timed Pulse	Output	6	TRIG 1, Pulse 5 TRIG 2, Pulse 6 TTL Output 1, Pulse 1 TTL Output 2, Pulse 2 TTL Output 3, Pulse 3 TTL Output 4, Pulse 4	— — 4 6 7 18	— — 5 7 8 20
Watchdog	Output	1	TTL Output 0	3	4
General-Purpose	Output	3	TTL Output 5 TTL Output 6 TTL Output 7	19 21 22	21 23 24

Isolated Inputs and Outputs

The isolated inputs and outputs on the NI CVS-1450 device have a separate ground reference from the main NI CVS-1450 device supply, providing an easy means to prevent ground loops that can introduce noise into a system. You can apply signals up to 30 V to the isolated inputs. The voltage swing of the isolated outputs is determined by the V_{iso} you supply on the connector.

Note The isolated outputs have current-limiting protection circuitry. If this circuitry is tripped, you can re-enable the outputs by restarting the NI CVS-1450 device or by toggling the output state in the software.

Table 3-2 summarizes the isolated inputs and outputs available on the NI CVS-1450 device.

Table 3-2. Isolated Inputs and Outputs

Primary Function	Input or Output	Number Available	Signal Names	44-Pin DSUB on NI CVS-1450 Device Pin Number	37-Pin Terminal Block Pin Number
Trigger	Input	3	TRIG 0 ISO Input 5† ISO Input 8	— 35 40	— 15 27
Quadrature Encoder	Input	1	ISO Input 6 ISO Input 7	37 38	25 26
External Shutdown Control	Input	1	ISO Input 11	44	31
Product Selection Port†	Input	1	ISO Input 0 ISO Input 1 ISO Input 2 ISO Input 3 ISO Input 4	15 30 31 32 34	9 10 11 13 14
General-Purpose	Input	2	ISO Input 9 ISO Input 10	41 43	29 30
General-Purpose	Output	4	ISO Output 0 ISO Output 1 ISO Output 2 ISO Output 3	12 13 27 28	19 35 36 37

† ISO Input 5 can also function as a latch for the product selection port.

I/O for Normal Operation

The following sections describe I/O functions that are available on the NI CVS-1450 device during normal operation.

Trigger Inputs

Trigger inputs are available from both TTL inputs and isolated inputs. You can use these trigger inputs to synchronize the NI CVS-1450 device with an external event, such as the assertion of a signal generated by a proximity sensor or a PLC to indicate that an inspection item is passing in front of the camera. The NI CVS-1450 device uses this input to initiate a timed pulse

that can be used for camera control, lighting control, encoder pulse counting, and result output timing.

For more information about creating a timed pulse output, refer to the *Timed Pulse Output* section.

TTL Input 0, TTL Input 1, TRIG 0, and ISO Input 8 can alternatively function as general purpose inputs. ISO input 5 can alternatively function as a latch input for the product selection port.

Timed Pulse Output

The NI CVS-1450 device is capable of timed pulse output on six different digital outputs, which provides precise control over time-critical signals, such as camera exposure. This section describes the various uses for the timed pulse output and the parameters you can set to control these outputs.

Uses for timed pulse output include controlling camera reset and exposure, controlling strobe lighting, operating plungers on an assembly line, and communicating with PLCs. You can configure the start of the pulse output generation to occur from software or from a rising or falling edge of a trigger input.

In addition to controlling the timing of pulse output, you can also configure the polarity of the output signal, resulting in a high-true or low-true signal. Based on the polarity setting, the output signal asserts after the appropriate delay time and de-asserts after the configured pulse width. You can set the delay time in microseconds or in quadrature encoder counts from the start signal—either a hardware trigger or a software command. Width is always configured in microseconds.

Initiating a Timed Pulse

Each timed pulse generator has a trigger input that specifies whether to wait on a particular trigger input to generate the pulse or to immediately generate the pulse when software sets the pulse mode to **Start**.

When the pulse generator is configured for a particular trigger input, after generating a pulse, it waits for another trigger before generating another pulse. When the pulse generator is configured to immediately generate the pulse on a software start, after generating a pulse, it immediately generates another pulse.

If the trigger input is set to **Immediate**, the pulse generation occurs as soon as the pulse mode is set to **Start**. If the trigger input is set to one of the hardware trigger inputs, the timed pulse output waits for an assertion edge on the appropriate trigger input. The assertion edge is configurable based on the trigger polarity parameter. It then generates one pulse and rearms to wait for the next trigger. In either case, the pulse output generation stops and resets if the pulse mode parameter is set to **Stop**.

Figure 3-1 shows an output pulse when a trigger is selected.

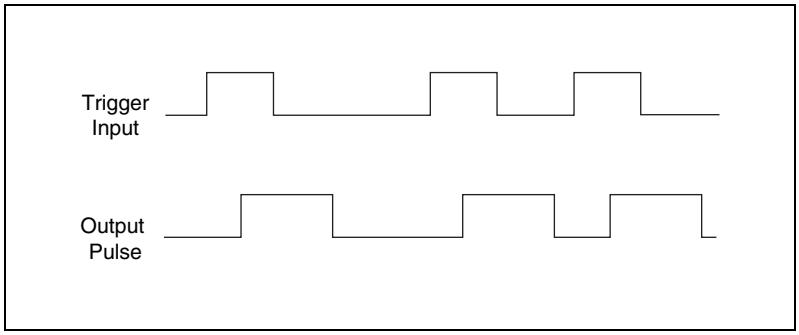


Figure 3-1. Output Pulse When Trigger Is Selected

Pulse Modes

Each pulse generator has a Start and a Stop mode. Configure the pulse generator when in Stop mode and then set it to Start mode.

Pulse Delay

Pulse delay is the amount of time between a trigger and the first (assertion) edge of an output pulse. The pulse delay is configurable in units of microseconds or quadrature encoder counts. If configured for microseconds, available values are between 10 µs and 4,294,967,295 µs, which is 4,294 seconds, or approximately 71 minutes. If the delay is configured for quadrature encoder counts, the range of choices is 0 counts to 4,294,967,295 counts.

Pulse Width

Pulse width is the amount of time between the first (assertion) edge of a pulse and the second (deassertion) edge. Pulse width is configurable only in microseconds from 10 µs to 4,294,967,295 µs.

Trigger Polarity

Each pulse generator can be individually configured for rising or falling edge triggering. Even if multiple pulse generators are using the same trigger, each can have different polarities.

Figure 3-2 shows the output of a pulse generator configured to look for a rising edge trigger and output a high pulse with a microsecond width and delay.

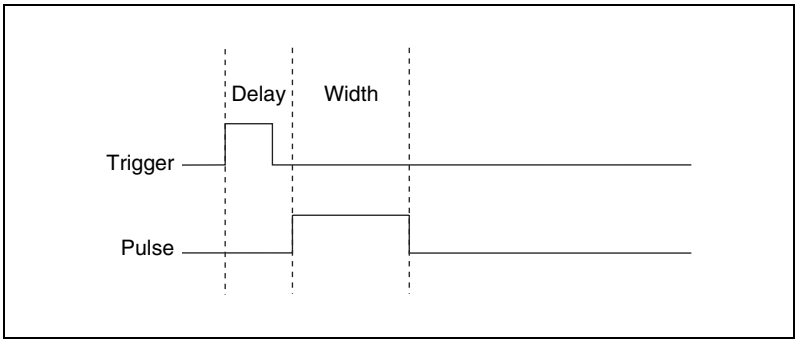


Figure 3-2. High Pulse with Rising Edge Trigger

Figure 3-3 shows how to create a high and low pulse train with a microsecond delay and width.

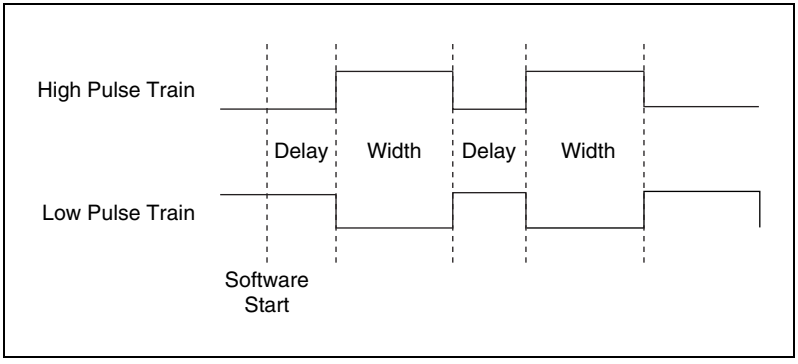


Figure 3-3. High and Low Pulse Trains

Quadrature Encoder

The quadrature encoder uses ISO Input 6 for its Phase A input and ISO Input 7 for its Phase B input. Encoder speed is limited by the speed of the isolated inputs. Each isolated input can change at a maximum rate of 100 kHz, making the maximum encoder rate 400,000 counts/s.

The quadrature encoder can also be used as a timebase for the pulse generation delay.

Figure 3-4 shows a rising edge trigger and a low pulse with a quadrature encoder delay and a microsecond width.

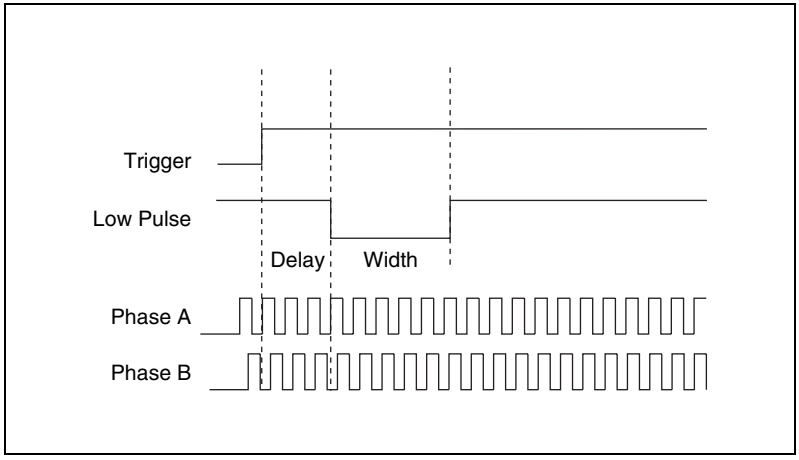


Figure 3-4. Rising Edge Trigger, Low Pulse with a Quadrature Encoder Delay

Product Selection Port

The product selection port consists of a group of five isolated digital inputs that the software running on the NI CVS-1450 device reads simultaneously. You can program the NI CVS-1450 device to switch between up to 32 (2^5) inspection sequences for different parts on an assembly line.

Based on the input to the product selection port, you can configure the application software to run the appropriate inspection sequence. For example, an upstream NI CVS-1450 device programmed for part classification might drive the product selection port of a downstream NI CVS-1450 device. Alternatively, a PLC with information about which part is being inspected can drive the product selection port of the NI CVS-1450 device.

Using ISO Input 5 as a Latch

You can configure the product selection port to use ISO Input 5 as a latch. A rising edge on ISO Input 5 can latch the data into a data register on the NI CVS-1450 device. Before each inspection, the software checks the status of the product select inputs and reads the most recent value latched into the register.

Note In Vision Builder AI, ISO Input 5 is always designated as a latch.

Table 3-3 lists the product selection ports.

Table 3-3. Product Selection Port

Function	External Connection
Data(5), rising edge latch	ISO Input 5
Data(4)	ISO Input 4
Data(3)	ISO Input 3
Data(2)	ISO Input 2
Data(1)	ISO Input 1
Data(0)	ISO Input 0

General-Purpose I/O

General-purpose inputs and outputs are available as both TTL and isolated connections. At any time, the software running on the NI CVS-1450 device can read the inputs and drive the outputs high or low.

General-Purpose Inputs

The primary difference between general-purpose inputs and trigger inputs is that you cannot use general-purpose inputs to initiate a timed pulse generator. In an application, use the general-purpose inputs to get the status of the inputs at a given point and not to synchronize the NI CVS-1450 device with an external event.

An example of how to use general-purpose inputs is reading the status of a general-purpose input as the first step in your inspection sequence and recording that value as part of your inspection.

General-Purpose Outputs

The primary difference between general-purpose outputs and timed pulse outputs is that the timing of general-purpose outputs is controlled by software rather than hardware. As a result, timing of general-purpose outputs changes as the inspection algorithm changes, which makes general-purpose outputs less appropriate than timed outputs for camera control, strobe light control, and other applications that require precise timing.

An example of using general-purpose outputs is driving a relay that turns on an Inspection in Progress light for an operator to see while the inspection sequence is running.

I/O for Fault Conditions

The NI CVS-1450 device recognizes the following fault conditions:

- External shutdown, when shutdown mode is enabled
- Watchdog timer expiration
- Overheat

The behavior of the NI CVS-1450 device in the event of a fault condition is dependent on configuration settings of the **SAFE MODE** DIP switch and the software-enabled shutdown mode. Table 3-4 summarizes how user configuration affects the behavior of the NI CVS-1450 device in the event of a fault condition. To resume operation, address the fault condition and reset the NI CVS-1450 device. The following sections describe each fault condition.

Table 3-4. Configuration Settings and Effects

Fault Condition	Configuration Settings		Configuration Effects	
	SAFE MODE DIP	Shutdown Enabled	Processing Halts	Outputs Change to User-Defined States
External Shutdown	On	N/A	N/A	No
	Off	On	Yes	Yes
	Off	Off	No	No
Watchdog	On	N/A	N/A	No
	Off	On	Yes	Yes
	Off	Off	Yes	No
Overheat	On	N/A	Yes	No
	Off	On	Yes	Yes
	Off	Off	Yes	No

Shutdown

Shutdown mode is a software-enabled feature, that when activated, allows an external device to halt the NI CVS-1450 device processing operations. Additionally, shutdown mode allows you to specify user-defined shutdown states for all fault conditions.

When shutdown mode is enabled and the shutdown input signal, ISO Input 11, turns off, the NI CVS-1450 device registers an external shutdown condition. When this fault occurs, the **POWER OK** LED turns red and all system operation halts. To resume operation, you must reset the NI CVS-1450 device.

For all fault conditions, outputs operate according to user-defined shutdown states. Each TTL output is configurable to drive high, drive low, or 3-state, and each isolated output is on/off configurable.

Shutdown mode is unavailable when the **SAFE MODE** DIP switch is turned on.

Refer to Table 3-4 for a summary of how user configuration affects the shutdown condition.

Disabling Shutdown Mode

To disable shutdown mode once it is enabled, remove shutdown mode from the software script and reset the NI CVS-1450 device. To reset the system, press the **RESET** button on the NI CVS-1450 device front panel for at least two seconds.

Note For prototyping when equipment is unavailable, you can wire from Viso to ISO Input 11 to simulate external equipment that indicates to the NI CVS-1450 device to operate normally.

Watchdog Timer

The watchdog timer is a software configurable feature that can monitor software on the NI CVS-1450 device and take action if the software is unresponsive. The millisecond counter on the watchdog timer is configurable up to 65,534 ms, in 1 ms increments, before it expires.

Configure the watchdog timer to take one of the following actions when it expires:

Caution Use the **Indicator Only** option *only* to test the watchdog timer. If software becomes unresponsive, it cannot be relied upon to send notification to the host.

- **Indicator Only**—This option sends the expiration signal back to the development machine through software. **True** indicates an expired watchdog timer. **False** indicates an unexpired watchdog timer. The expiration signal that indicates an expired watchdog timer continues to assert until the watchdog timer is disarmed. Disarming the watchdog timer resets the I/O.
- **TTL Output 0**—This option outputs a signal on TTL Output 0. A **High** on TTL Output 0 indicates that the watchdog timer has expired. **Low** indicates that it has not expired. If the watchdog timer has expired, the expiration signal continues to assert until the watchdog timer is disarmed.
- **System Shutdown**—This option halts the NI CVS-1450 device operation and turns the **POWER OK** LED red. If shutdown mode is enabled, the outputs go to the user-defined shutdown states.

Table 3-4 summarizes how user configuration affects the shutdown condition.

Note The **Watchdog Timer** feature is not supported by Vision Builder for Automated Inspection.

Overheat

Operating the NI CVS-1450 device outside of its temperature specifications may cause the NI CVS-1450 device to overheat. Refer to the *Specifications* section of *Getting Started with the NI CVS-1450 Series Compact Vision System* for temperature specifications.

In the event of an overheat, all NI CVS-1450 device operation halts and the **POWER OK** LED turns red. If shutdown mode is enabled, the outputs go to the user-defined shutdown states.

Considerations When Connecting the Digital I/O

The isolated trigger inputs on the NI CVS-1450 device are current sinking and optically isolated. Figure 3-5 shows the trigger input interface circuit.

Wiring an Isolated Input to a Sourcing Output Device

You can wire an isolated input to a sourcing output device, as shown in the example in Figure 3-5. Refer to the *Specifications* section of *Getting Started with the NI CVS-1450 Series Compact Vision System* for switching thresholds and current requirements.

Caution Do *not* apply a voltage greater than 30 VDC to the isolated inputs. Doing so could damage NI CVS-1450 device.

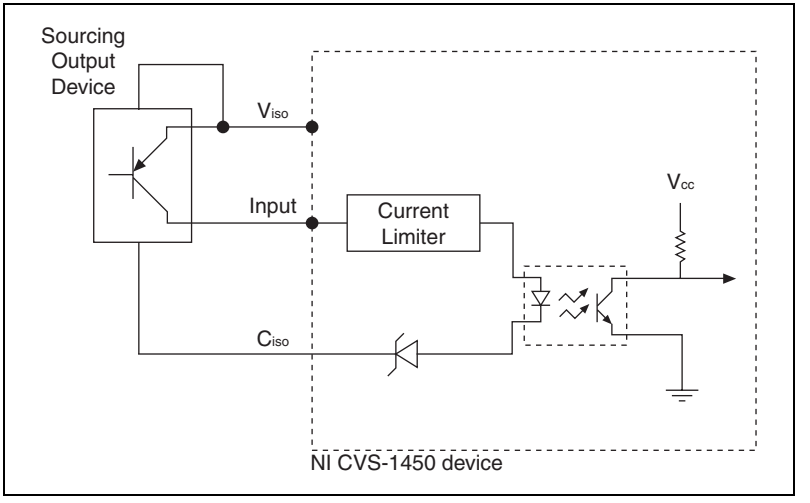


Figure 3-5. Example of Connecting an Isolated Input to a Sourcing Output Device

Wiring an Isolated Output to an External Load

The digital output circuit sources current to external loads, as shown in the example in Figure 3-6.

Caution Do *not* draw more than 100 mA from 24 V or 30 V isolated outputs. Do *not* draw more than 50 mA from 5 V isolated outputs.

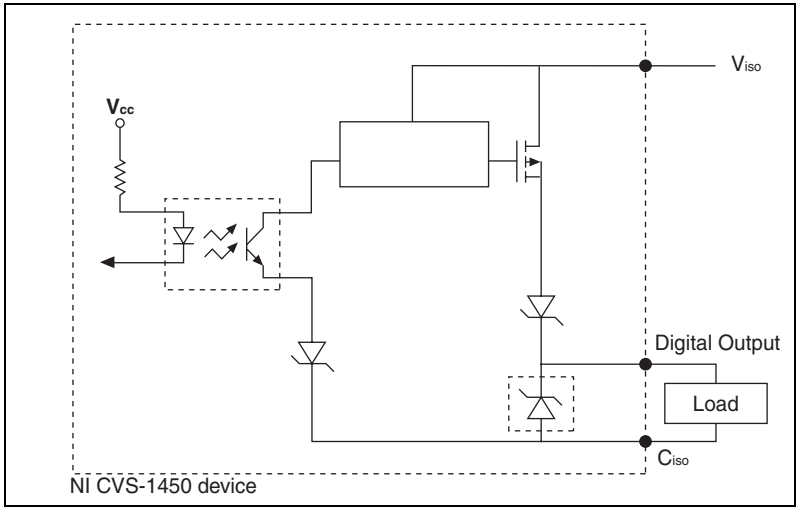


Figure 3-6. Example of Connecting an Isolated Output to an External Load

Protecting Inductive Loads

When an inductive load, such as a relay or solenoid, is connected to an output, a large counter-electromotive force may occur at switching time due to energy stored in the inductive load. This flyback voltage can damage the outputs and the power supply.

To limit flyback voltages at the inductive load, install a flyback diode across the load. Mount the flyback diode as close to the load as possible. Use this protection method if you connect any of the isolated outputs on the NI CVS-1450 device to an inductive load.

Figure 3-7 shows an example of using an external flyback diode to protect inductive loads.

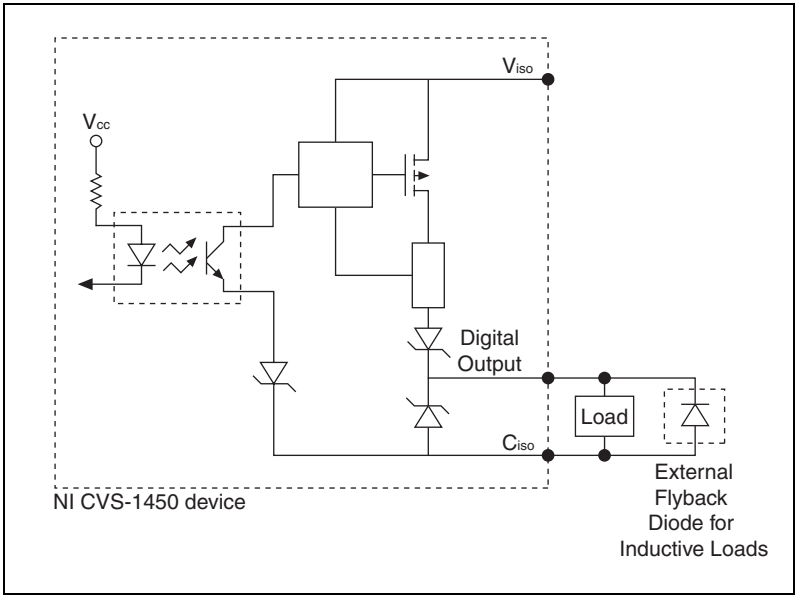


Figure 3-7. Example of Using an External Flyback Diode for Inductive Loads

Transmission Line Effects

Transmission line effects can degrade the signals on the I/O cables and cause instability. To minimize transmission line effects, use twisted-pair wires with a characteristic impedance of 118 Ω to connect external signals to the 44-pin I/O DSUB connector. Use a 75 Ω coaxial cable, such as RG-179, to connect to the SMB connectors.

Figure 3-8 shows connections to the 44-pin DSUB connector and the TRIG 0 SMB connector that minimize transmission line effects.

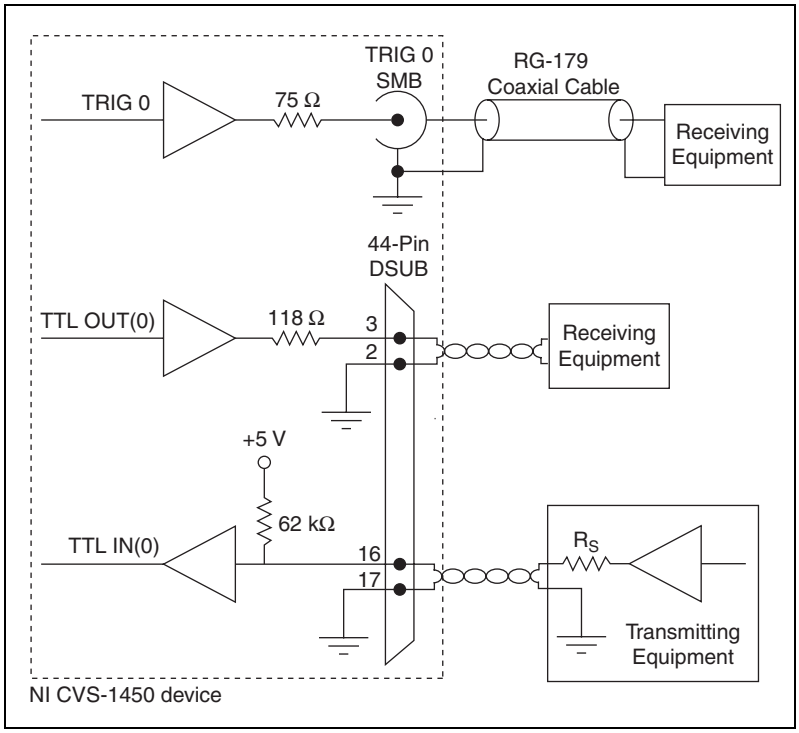


Figure 3-8. Example Connections

When connecting to TTL inputs on the NI CVS-1450 device, match the output impedance of the transmitting device to the characteristic impedance of the cable. For example, if the cable characteristic impedance is 118 Ω, make R_s equal to 118 Ω, as shown in Figure 3-8.

Typical System Setup

Digital I/O configuration varies depending on the number of cameras your system setup requires. You can access the digital I/O through the 44-pin DSUB connector or through the three SMB connectors.

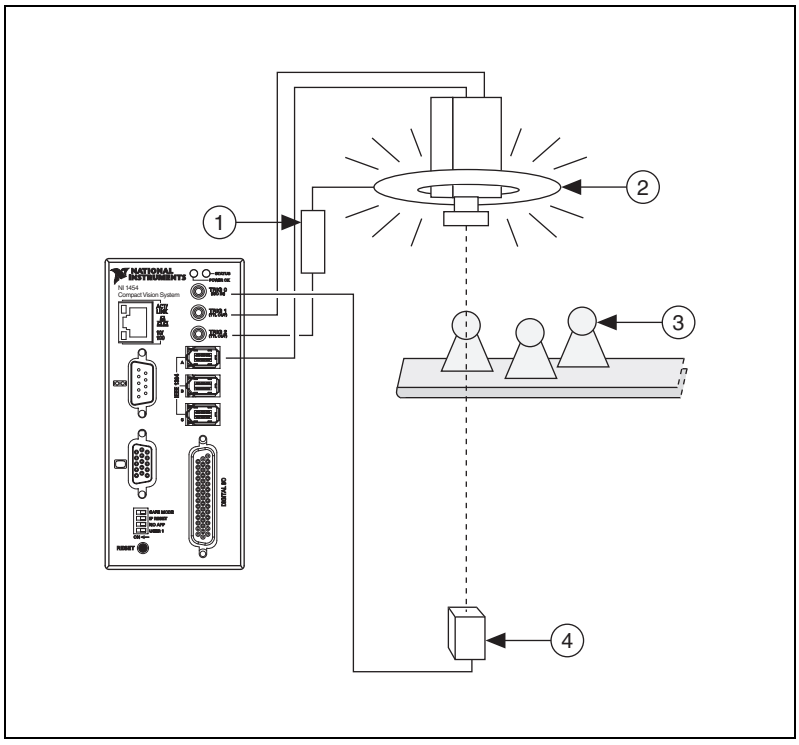
The digital I/O capabilities of the SMB connectors on the NI CVS-1450 device are ideal for typical single-camera applications. The SMB connectors are labeled **TRIG 0**, **TRIG 1**, and **TRIG 2**.

Table 3-5 summarizes a typical single-camera configuration.

Table 3-5. Typical Single-Camera System Setup

Signal Name	Signal Type	Purpose
TRIG 0	Isolated input	Trigger input from proximity sensor or external device
TRIG 1	Timed pulse TTL output	Exposure start and control signal to camera
TRIG 2	Timed pulse TTL output	Strobe light control

Figure 3-9 illustrates a typical single-camera setup.



1	Lighting Control Unit	3	Inspection Items
2	Lighting Ring	4	Proximity Sensor

Figure 3-9. Typical Single-Camera Setup

4

Deployment

This chapter provides guidelines for connecting the NI CVS-1450 device to a network.

Connecting Multiple NI CVS-1450 Devices

An Ethernet connection between the development computer and the NI CVS-1450 device allows you to assign an IP address, configure the NI CVS-1450 device, download inspection tasks, and remotely monitor an ongoing inspection.

As with all Ethernet devices, you can connect multiple NI CVS-1450 devices to the same network, as shown in Figure 4-1.

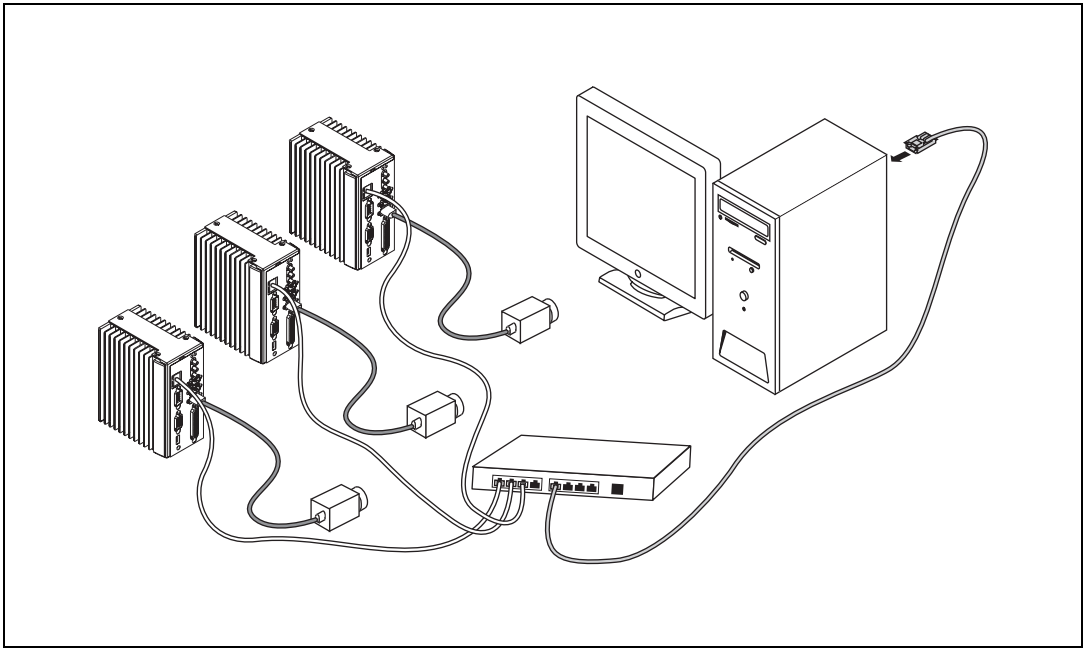


Figure 4-1. Multiple NI CVS-1450 Devices Connected to the Same Network

To connect multiple NI CVS-1450 devices to the same network, each NI CVS-1450 device must have a unique IP address. By default, the configuration utility running on the development computer displays each NI CVS-1450 device that exists on the subnet. To add entries for NI CVS-1450 devices that exist on other subnets, you must know the IP address assigned to each NI CVS-1450 device. This feature allows remote configuration, programming, and monitoring of any NI CVS-1450 device not protected by a firewall or user password.

Use the NI CVS-1450 device serial number and media access control (MAC) address to uniquely identify each unit. The serial number and MAC address are printed on the top side of each NI CVS-1450 device, as shown in Figure 4-2.

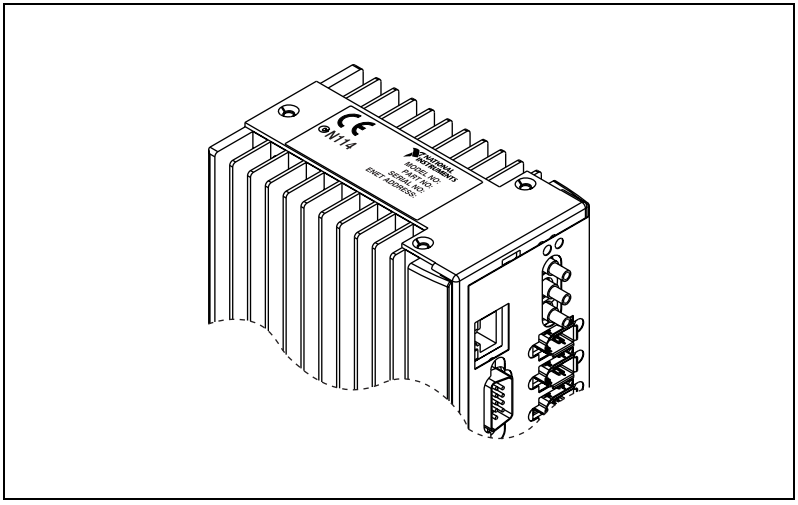


Figure 4-2. Serial Number and MAC Address Label on the NI CVS-1450 Device

The configuration environment on the host machine displays these values in order to distinguish one NI CVS-1450 device from another. In addition to distinguishing units based on serial number and MAC address, you can also assign each NI CVS-1450 device a descriptive name in the configuration environment.

When configured to run an inspection, the NI CVS-1450 device can run autonomously without connection to the host machine. All image acquisition, inspection, decision making, and I/O occurs on the NI CVS-1450 device itself. For local monitoring of the inspection, you can connect a monitor directly to the **Video Out** connector on the NI CVS-1450 device, as shown in Figure 4-3.

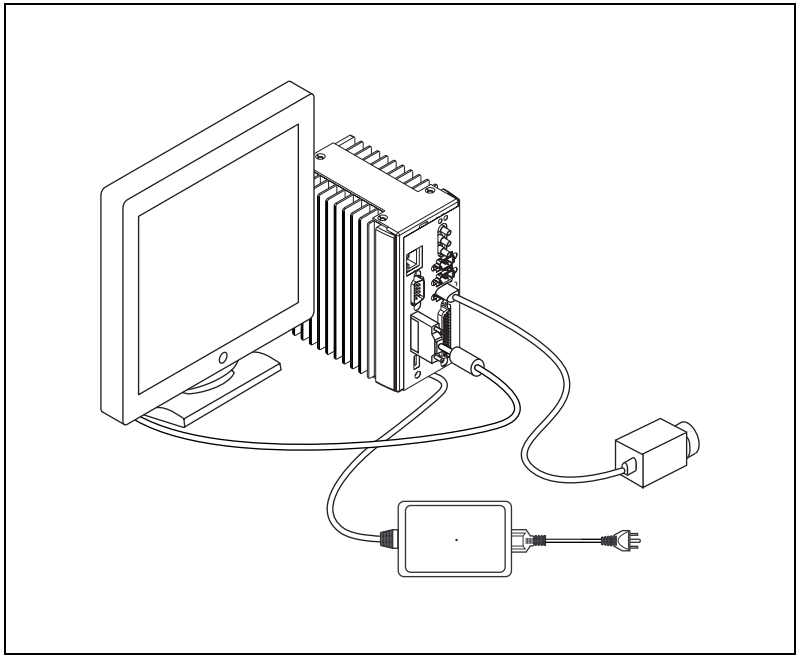


Figure 4-3. NI CVS-1450 Device Connected to a Monitor

At any time, you can reconnect the host machine to the NI CVS-1450 device and remotely monitor progress.

A

Troubleshooting

This appendix provides instructions for troubleshooting the NI CVS-1450 device.

Software Configuration Problems

NI CVS-1450 Device Does Not Appear in MAX or in Vision Builder AI

Possible causes and solutions:

- Verify that there is power to the NI CVS-1450 device and that both the NI CVS-1450 device and the development computer are properly connected to the network. The **POWER OK** LED should be lit. When you click **Browse**, the **ACT/LINK** LED on the NI CVS-1450 device should flash to indicate that communications are taking place.
- Certain network devices, such as switches and routers, may filter out the directed UDP broadcast packets the development computer uses to communicate with unconfigured NI CVS-1450 devices, even if these devices are on the same subnet. You can test this by connecting the development computer and the NI CVS-1450 device directly to a network port or by using a crossover cable between the NI CVS-1450 device and the development computer. If the NI CVS-1450 device appears in the software using this configuration, but not when connected to the larger network, the network is not properly communicating with the NI CVS-1450 device. Consult your network administrator.
- The NI CVS-1450 device may have been configured on another network and then moved to the current network. Reconfigure the NI CVS-1450 device on the current network.
- The grade of cable you are using may be insufficient for the speed of your network, or you may be using the wrong type of Ethernet cable. Use a straight-through cable when connecting to network hardware. Use a crossover cable to connect directly to the development computer.

- Another device on the network is using the IP address assigned to the NI CVS-1450 device. Either remove or reconfigure the other device, or reconfigure the NI CVS-1450 device IP address.
- The DIP switch settings on the NI CVS-1450 device may be invalid, such as all switches set to the **ON** position. Change the DIP switch settings and reset the NI CVS-1450 device by pressing the **RESET** button on the NI CVS-1450 device for at least two seconds.
- The CVS-1450 device is configured to acquire an IP address from a DHCP server, but no DHCP server is available. After three unsuccessful attempts to acquire an IP address from a DHCP server, the CVS-1450 device will reboot and enter an unconfigured state.

  In the unconfigured state, the CVS-1450 device will have an IP address of `0.0.0.0` and the LabVIEW Real-Time engine will not load. In the unconfigured state, the CVS-1450 device has network connectivity. If the CVS-1450 device is on the same subnet as the host computer, then refreshing the list of remote devices in MAX or Vision Builder AI will cause the CVS-1450 device to appear with an IP address of `0.0.0.0`. Use MAX or Vision Builder AI to reconfigure the CVS-1450 device IP address. Then reboot the CVS-1450 device.

Error When Configuring IP Settings for the NI CVS-1450 Device

The NI CVS-1450 device cannot be configured if the subnet mask or IP address is incompatible with the network settings. Verify that the values entered for all network parameters are valid.

Status of NI CVS-1450 Device in MAX and Vision Builder AI is No Software Installed

Install application and driver software on the NI CVS-1450 device. Refer to *Getting Started with the NI CVS-1450 Series Compact Vision System* for installation instructions.

No Camera Found

Verify that the total power requirements of the cameras do not exceed the power the NI CVS-1450 device provides on the IEEE 1394 bus. Verify that the cameras comply with the *IIDC Digital 1394-based Camera Specification, Version 1.30*.

Formatting the NI CVS-1450 Device Compact Flash Memory

Complete the following steps to format the Compact Flash memory and restore the NI CVS-1450 device to its original state.

Caution Formatting the Compact Flash memory overwrites all of the files on the NI CVS-1450 device. Back-up any user data files you want to preserve to another computer before formatting the Compact Flash memory.

1. Start the NI CVS-1450 device in safe mode. To start in safe mode, enable the **SAFE MODE** DIP switch on the front of the NI CVS-1450 device and restart the device.
2. Launch MAX.
3. In the MAX configuration tree, expand **Remote Systems**.
4. Right-click the name of the device you want to reformat and select **Format Disk**.

   The video output connected to the NI CVS-1450 device displays the status of the format.
5. After the format completes, disable the **SAFE MODE** switch, and restart the device.
6. Refer to *Getting Started with the NI CVS-1450 Series Compact Vision System* for information about configuring the NI CVS-1450 device for your application.

Hardware Errors

POWER OK LED is Red

The NI CVS-1450 device is in one of the following fault conditions:

- Shutdown enabled in software, but ISO Input 11 is not turned on
  - ISO Input 11 is used to indicate to the NI CVS-1450 device that all external devices are ready for operation. When ISO Input 11 turns off, the NI 1450 shuts down. Either turn on ISO Input 11 with an external source and reset the NI CVS-1450 device, or disable Shutdown in the software.

Note For prototyping when external equipment is unavailable, V_{iso} can be wired to ISO Input 11 to turn on the NI CVS-1450 device.

- Watchdog timer expired while configured for the system shutdown option
  - Determine if the interval between watchdog timer resets is insufficient for the processing time. Check the software to determine if it could monopolize the processor.
- Processor overheat
  - Make sure you are operating the NI CVS-1450 device in compliance with the temperature specifications in *Getting Started with the NI CVS-1450 Series Compact Vision System*.

Refer to Table 3-4, *Configuration Settings and Effects*, for more information about fault conditions.

Cannot Drive Isolated Outputs

Verify that you have power connected to V_{iso} and C_{iso} inputs on the NI CVS-1450 device power connector and that the contact at the screw terminals is solid. Because these outputs are electrically isolated from the NI CVS-1450 device main supply, they require power in addition to the NI CVS-1450 device main supply.

Runaway Startup Application

If a runaway startup application causes the NI CVS-1450 device to become unresponsive, power off the NI CVS-1450 device and then restart it with either the **NO APP** switch or the **SAFE MODE** switch in the **ON** position. Restarting the NI CVS-1450 device with the **NO APP** switch enabled prevents any VIs from running at startup. Restarting with the **SAFE MODE** switch enabled starts the NI CVS-1450 device in safe mode and does not launch the embedded LabVIEW RT engine. Refer to the *DIP Switches* section of Chapter 2, *LEDs, DIP Switches, and Connectors*, for more information about these DIP switches.

System Displays a Missing Operating System Error at Startup

The NI CVS-1450 device was powered on or reset with all DIP switches in the **ON** position. Set the DIP switches to the off position, and reset the NI CVS-1450 device by pressing the **RESET** button for at least two seconds.

LED Error Indications

The NI CVS-1450 device indicates specific error conditions by flashing the orange **STATUS** LED a specific number of times. Table A-1 describes the **STATUS** LED flashing sequences and the corresponding error condition.

Table A-1. STATUS LED Flashes and Corresponding Error Conditions

Number of Flashes	Error Condition
0 (stays lit)	The NI CVS-1450 device has detected an internal error. Contact National Instruments for assistance.
1	The NI CVS-1450 device is unconfigured.
2	The NI CVS-1450 device has detected an error in its software. This usually occurs when an attempt to upgrade the firmware is interrupted. Repeat the firmware upgrade process.
3	The NI CVS-1450 device is in safe mode.
4 (or more)	The NI CVS-1450 device has detected an unrecoverable error. Contact National Instruments for assistance.

POWER OK LED Is Not Lit When the NI CVS-1450 Device is Powered On

If the power supply is properly connected to the NI CVS-1450 device, but the **POWER OK** LED does not light up, check that the power supply is 24 VDC ±10% and within the specifications outlined in *Getting Started with the NI CVS-1450 Series Compact Vision System*. Using a power supply that is not within these specifications might result in an unresponsive or unstable system and could damage the NI CVS-1450 device.

B

Mounting Information

This appendix provides the information necessary to create a custom mount for the NI CVS-1450 Series.

If you do not want to create a custom mount, a panel and DIN rail mount kit for the NI CVS-1450 Series is available from National Instruments (part number 189154-01).

Mounting the NI CVS-1450 Series

If you want to create a custom mount, Figures B-1 through B-4 provide dimensional drawings and clearance information for the NI CVS-1450 Series.

Caution If you choose not to mount the NI CVS-1450 device on a DIN rail or flat surface, do *not* position the NI CVS-1450 device with the heat sinks resting on any surface. Doing so may cause the NI CVS-1450 device to overheat. Refer to *Getting Started with the NI CVS-1450 Series Compact Vision System* for temperature specifications.

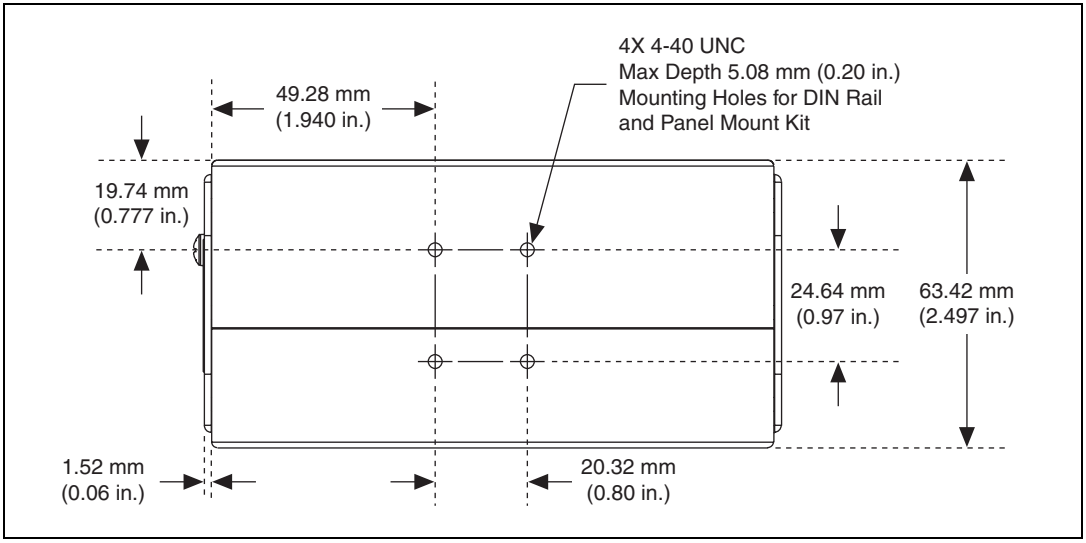


Figure B-1. Back View of the NI CVS-1450 Series with Dimensions

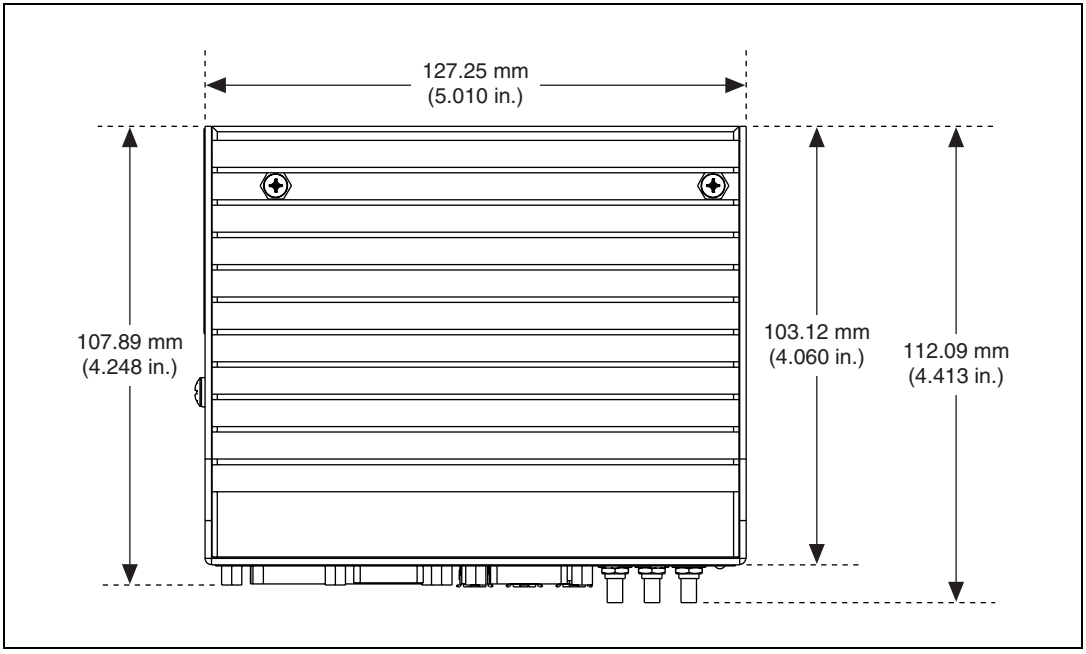


Figure B-2. Side View of the NI CVS-1450 Series with Dimensions

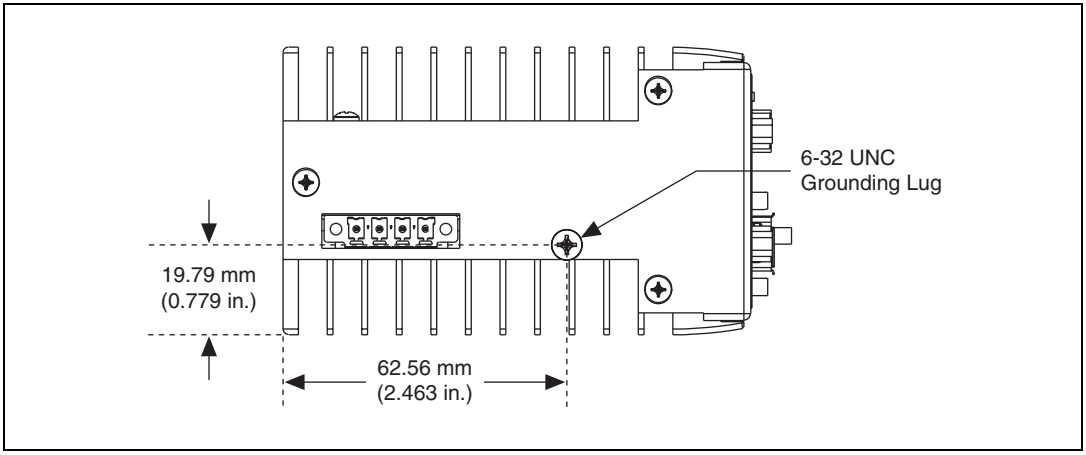


Figure B-3. Bottom View of the NI CVS-1450 Series with Dimensions

Note You can ground the NI CVS-1450 device to your mount by connecting a grounding wire to the grounding lug on the NI CVS-1450 device. Refer to the *Earth Ground Connection* section of Chapter 2, *LEDs, DIP Switches, and Connectors*, for more information about the grounding lug.

Caution Your installation must meet the following space and cabling clearance requirements for optimum cooling:

- Allow 76.2 mm (3.0 in.) on the top and bottom of the NI CVS-1450 device for air circulation.
- Allow 50.8 mm (2.0 in.) on the sides of the NI CVS-1450 device for air circulation.
- Allow enough space in front of the NI CVS-1450 device to connect cables.

Refer to Figure B-4 for a illustration of the space and cabling requirements for the NI CVS-1450 Series.

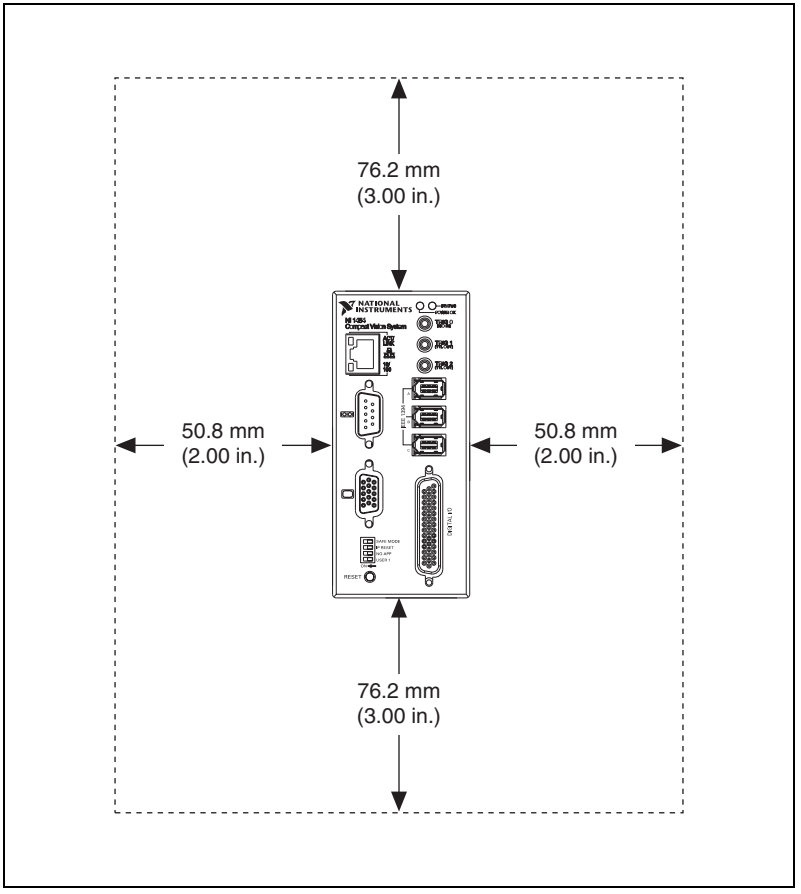


Figure B-4. Space and Cabling Clearance for the NI CVS-1450 Series

Complete the following steps to secure the NI CVS-1450 device to your mount.

1. Align the screw holes of your mounting bracket with the four holes on the back of the NI CVS-1450 device. Figure B-1 shows the location of the mounting holes on the NI CVS-1450.
2. Insert four 4-40 UNC screws and tighten them until they are secure (3.5 in.-lb). Make sure that the heads of the screws are flush with the mounting bracket.

C

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources at ni.com/support include the following:
  - **Self-Help Resources**—For answers and solutions, visit the award-winning National Instruments Web site for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on.
  - **Free Technical Support**—All registered users receive free Basic Service, which includes access to hundreds of Application Engineers worldwide in the NI Discussion Forums at ni.com/forums. National Instruments Application Engineers make sure every question receives an answer.

    For information about other technical support options in your area, visit ni.com/services or contact your local office at ni.com/contact.
- **Training and Certification**—Visit ni.com/training for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit ni.com/alliance.
- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification.

- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

If you searched `ni.com` and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

Symbol	Prefix	Value
μ	micro	10^{-6}
m	milli	10^{-3}
k	kilo	10^{3}
M	mega	10^{6}

B

buffer — Temporary storage for acquired data.

D

DCAM-compliant — Cameras that comply with the *IIDC 1394-based Digital Camera Specification, Version 1.30.*

DIP switch — Dual Inline Package switch.

E

Ethernet cable, standard — CAT-5 or CAT-6 Ethernet cable used to connect a Real-Time target to a network port.

Ethernet crossover cable — CAT-5 or CAT-6 cable used for direct connection between the development computer and the Real-Time target.

F

falling edge — The digital signal transition from the high state to the low state.

I

IEEE — Institute of Electrical and Electronics Engineers. A standard-setting body.

L

LED	Light-emitting diode.

M

MAC	Media access control. The MAC address uniquely identifies each unit connected to a network.

N

NI-IMAQdx	Driver software for National Instruments IEEE 1394 and Gigabit Ethernet interface devices.

P

PLC	Programmable Logic Controller. An industrial computer used for factory automation, process control, and manufacturing systems.
pulse train	A signal consisting of a series of continuous pulses.

R

rising edge	The digital signal transition from the low state to the high state.
RS-232	Standard electrical interface for serial data communications.

S

subnet	A set of systems whose IP addresses are configured such that they can communicate directly with one another. Data will not flow through an intermediate router.

T

TCP	Transmission Control Protocol. A set of standard protocols for communicating across a single network or interconnected set of networks. TCP is for high-reliability transmissions.
trigger	Any event that causes or starts some form of data capture.

U

UDP	User Datagram Protocol. A set of standard protocols for communicating across a single network or interconnected set of networks. UDP is for low-overhead transmissions.

V

VDC	Volts direct current.
VI	Virtual Instrument. A combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument.

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